

SR. VOTE CARD 2002

Should Argyle fuel its municipal fleets with biodiesel?

Energy Source: Biodiesel is a renewable fuel made from vegetable oil or animal fats that can be grown on farms within the country.

Pollution: Biodiesel emits less pollutants than petroleum diesel: carbon monoxide emissions are reduced by 50%, unburned hydrocarbons by 93%, particulates by 30%, and sulfur by 100%.

Greenhouse Effect: Biodiesel reduces "net" carbon dioxide emissions by 78% compared to petroleum diesel. This net reduction is possible because plants being grown for biodiesel absorb carbon dioxide from the atmosphere as they are growing. Petroleum diesel is pumped up from the earth adding that "extra" carbon to the atmosphere.

Land & Wildlife: Biodiesel is biodegradable and non-toxic. If it is stored for long periods of time, however, biodiesel can oxidize and spontaneously combust. This could cause significant environmental damage.

Investment Cost: Moderate. Includes the cost of designing and building facilities to grow, collect, purify, store, and distribute biodiesel in Argyle.

Hidden Costs: Modifications to the fuel storage system and engines are required, as rubber dissolves in biodiesel. The vehicles will also need engine fuel filter heaters to avoid fuel flow problems in the winter.

Revenue: An excellent lubricant, it can extend the life of a diesel engine.

Discuss this issue for 5-10 minutes, then vote YES or NO.

Do not look at the back of this card until *after* the vote.

SR. VOTE CARD

Should Argyle provide a tax refund to consumers who purchase gasoline-electric hybrid vehicles in the next year?

Energy Production: Argyle would like to encourage 10% of its citizens to purchase environmentally friendly vehicles to improve air emissions and conserve gasoline.

Energy Source: Fuel for hybrid vehicles can be any renewable or non-renewable energy source; electric hybrids on the market today use gasoline as an energy source to charge very large batteries.

Pollution: Hybrids pollute less because the smaller, internal combustion engine is not in operation all of the time. The smaller cars are made of lightweight materials and are aerodynamically-designed.

Greenhouse Effect: Hybrid vehicles emit fewer pollutants. Depending on the fuel source, hybrids produce anywhere from 1/3 to 1/2 less greenhouse gases than gasoline-powered cars.

Land & Wildlife: Although unlikely, toxic acids from the batteries, leakage of fuel, and unprotected exposure to high voltages could be harmful to the environment and to the people maintaining the cars.

Investment Cost: Moderate. Argyle is proposing a \$5000 tax refund to anyone who buys a hybrid gasoline-electric car within the next year.

Hidden Costs: Training of maintenance mechanics and owners of hybrids in the new and more complex computerized systems.

Discuss this issue for 5-10 minutes, then vote YES or NO.

Do not look at the back of this card until *after* the vote.

SR. VOTE CARD 2002

Do we convert all gas-powered buses to liquefied petroleum gas?

Energy Production: To reduce air pollution in Bunk, the city has decided it would like to fuel its public buses with liquefied petroleum gas.

Energy Source: Liquefied petroleum gas is a non-renewable energy source. It is a byproduct of natural gas processing and oil refining.

Pollution: Liquefied petroleum gas' high octane rating (104) results in lower air pollution emissions than gasoline. Refueling can be a source of air pollution unless care is taken to install special refueling valves.

Greenhouse Effect: Liquefied petroleum gas (lpg) burns cleaner than gasoline, and emits 40% fewer greenhouse gases.

Land & Wildlife: Leakage of lpg vapors from storage tanks could be lethal if inhaled, and its extreme volatility could make it difficult to control in case of an accident. Fortunately, liquefied petroleum gas is not water-soluble, so it is not a potential hazard to ground water sources like gasoline.

Investment Cost: Low to moderate. Bunk would need to invest in liquefied petroleum gas storage tanks and delivery systems. Special tanks and refueling valves are needed on lpg systems to ensure that pollutants aren't released into the atmosphere.

Revenue: Buses powered by this fuel enjoy a lower cost of maintenance, saving taxpayers hundreds of thousands of dollars over the long term.

Discuss this issue for 5-10 minutes, then vote YES or NO.

Do not look at the back of this card until *after* the vote.

SR. VOTE CARD 2002

Should Argyle convert its fleet of ambulances and emergency vehicles to methanol?

Energy Production: Methanol would provide a reliable and economical source of energy for their emergency vehicles.

Energy Source: Methanol can be produced from almost anything containing carbon, including natural gas, coal, and biomass. Argyle will obtain its methanol from decaying plant matter collected by residents on trash day. The Wiggly Ocean, a source for natural gas, is another option.

Pollution: Methanol's high octane rating (102) results in lowered air pollution levels when compared to gasoline.

Land & Wildlife: Tanks for storing methanol might create a potential for spills that contaminate groundwater.

Investment Cost: Moderate. Includes designing and building facilities to collect, store, and distribute methanol. Produced in Argyle, it will result in lower, more stable prices and a lack of dependence on outside sources.

Hidden Costs: Due to methanol's corrosive nature, fuel tanks and dispensing equipment must be made of corrosion resistant materials.

Discuss this issue for 5-10 minutes, then vote YES or NO.

Do not look at the back of this card until *after* the vote.

STATUS REPORT

Hybrid Electric Vehicles

If you voted YES:

Energy: You have helped Argyle to reduce its gasoline consumption significantly. Your electricity source is less polluting than burning the gasoline. *Gain 2.*

Environment: The citizens who have taken advantage of the tax incentive have helped to reduce air emissions from automobiles. *Gain 2.*

Economy: Argyle's tax incentive has boosted the economy. *Gain 1.*

If you voted NO:

Energy: Gas consumption continues to rise. Unless other sources are discovered and tapped, Argyle could face an energy crisis. *Lose 2.*

Environment: Air pollution levels are becoming unbearable in Argyle's cities. As a result, many citizens are moving to rural areas to escape the smog causing urban sprawl. *Lose 2.*

Economy: Industrial growth has prompted Argyle to become more dependent on foreign oil supplies. This increased reliance could have a negative effect on the economy, as oil supplies become scarce. *Lose 1.*

STATUS REPORT

Biodiesel

If you voted YES:

Energy: *An interesting choice!* You have chosen a renewable energy source that Argyle can provide at a reasonable cost. *Gain 2.*

Environment: Biodiesel has substantially reduced "net" carbon dioxide emissions because it burns much cleaner than petroleum. *Gain 2.*

Economy: Converting the country's municipal fleet and developing the fuel distribution infrastructure has proved to be more expensive than originally thought. A drought added to the problems of growing the plants. *Lose 2.*

If you voted NO:

Energy: An oil spill in the Wiggly Ocean has substantially decreased the country's supply of diesel (If you had voted "yes", biodiesel might have replaced the loss). *Lose 2.*

Environment: Argyle's air pollution levels continue to increase. It is not a coincidence that the reported number of asthma and lung disease cases is also rising, causing increased health costs for Argyle. *Lose 2.*

Economy: By not converting Argyle's diesel-powered fleet to biodiesel, you have saved the government a significant amount of money in vehicle retrofits and in infrastructure (fuel storage & distribution). *Gain 1.*

STATUS REPORT

Methanol

If you voted YES:

Energy: Innovative choice - you have chosen an energy source that Argyle can produce cheaply and in abundance. *Gain 2.*

Environment: The net decrease in greenhouse gases has helped to reduce carbon dioxin emissions. An earthquake damaged some of the new infrastructure built for methanol, spilling thousands of gallons into the groundwater. The ubiquitous gasoline infrastructure fared worse, however, and created more toxic damage, although it does not spread into the groundwater as fast. *Lose 1.*

Economy: Cleanup costs for the methanol spill were enormous because of its ability to quickly mix with groundwater, overcoming the savings of converting the ambulance fleet from gasoline to methanol. *Lose 2.*

If you voted NO:

Energy: An OPEC oil embargo has caused an energy crisis in Argyle. The country faces blackouts on a rolling basis for two years. *Lose 2.*

Environment: Increased carbon dioxide emissions are blamed for respiratory illnesses throughout Argyle. *Lose 2.*

Economy: By not investing in methanol, you have saved Argyle lots of money. This, however, is offset (in part) by the recession in Argyle's economy due to the oil embargo. *Gain 1.*

STATUS REPORT

Liquefied Petroleum Gas

If you voted YES:

Energy: *Congratulations!* You have elected to support a clean-burning energy source. Unfortunately, the availability of this resource is dependent upon the oil supply. *Gain 1.*

Environment: Bunk's air quality vastly improves. *Gain 2.*

Economy: A war in the Middle East threatens the availability of petroleum, raising prices. As a result, more people are using the buses instead of their cars. *Gain 1.*

If you voted NO:

Energy: Gasoline availability is becoming increasingly scarce due to a war in the Middle East. *Lose 2.*

Environment: Bunk's gasoline powered city buses continue to pollute the air; as a result, air quality worsens. *Lose 2.*

Economy: The war over access to oil in the Middle East triggers a recession in Argyle. *Lose 2.*

STATUS REPORT

Nuclear Power

If you voted YES:

Energy: You created a major energy source, **gain 7**.

Environment: The nuclear power plant has replaced some of the need for fossil fuel on Argyle, improving air quality. However, spent nuclear fuel is a serious threat to the environment, **lose 5**.

Economy: The nuclear power plant was expensive and the challenge of what to do with the nuclear waste will cost even more money, consumer electricity rates doubled after the plant closed to recover the cost of dismantling it, **lose 4**

If you voted NO:

Energy: You lost your chance for a major energy source, **lose 7**.

Environment: By not building the nuclear plant you have avoided the problem of what to do with the spent fuel, but fossil fuel usage continues to harm air quality, **gain 5**.

Economy: Although crops damaged by continued acid rain cost the farmers money, you saved millions by not building the nuclear power plant, **gain 4**

STATUS REPORT

Insulation

If you voted YES:

Energy: Congratulations! By insulating the homes of Argyle, you saved a lot of energy, **gain 2**.

Environment: Because people use less energy to heat their homes, there was less pollution from fossil fuels and air quality improved, **gain 2**.

Economy: Insulating homes was expensive, but the initial cost paid for itself in reduced heating bills, **gain 2**.

If you voted NO:

Energy: Argyle had a very cold winter. You used even more energy than normal, **lose 2**.

Environment: Increased winter use of fossil fuels caused much pollution; air quality suffered and many Argyleans went to the hospital with lung problems, **lose 2**.

Economy: The additional use of energy through the winter cost Argyleans a lot in added heating bills, **lose 2**.

ROLE CARD

The ENERGY MONITOR will:

- keep track of the energy points by moving the token up and down the energy scale
- make sure the group does have a blackout

The ENVIRONMENTAL WATCH-DOG will:

- keep track of the environment points by moving the token up and down the Environment scale each turn
- make sure the does not destroy the environment beyond repair

The TREASURER will:

- keep track of the economy points by moving the token up and down the economy scale each turn
- make sure the group does not go bankrupt

The TREASURER, ENVIRONMENTAL WATCH-DOG AND ENERGY MONITOR are in charge of keeping track of where their tokens are on the scale, in case the game gets bumped and their tokens fall off.

STATUS REPORT

Natural Gas Drilling and Pipeline

If you voted yes:

Energy: You provided heat for all Argyle residents, but natural gas reserves turned out to be lower than expected, lasting only 13 years, **gain 3**.

Environment: Recently developed technology for heating homes with natural gas is much more efficient. The result is a more complete combustion with fewer pollutants being released into the air. Air quality has improved, but a lot of land has been altered or damaged by the pipeline, and the fishing community on the Bing Islands has suffered from lower catches due to drilling, **gain 1**.

Economy: The plan was expensive and didn't last as long as expected, **gain 2**.

If you voted no:

Energy: Argyle's industry needed this energy resource. Now they have to import fuel from another country, **lose 3**.

Environment: Argyle's residents continue to heat using dirtier fuels, but you preserved important habitats along the pipeline corridor, **lose 1**.

Economy: The cost of importing fuel is high, **lose 2**.

STATUS REPORT

Solar Rooftops

If you voted YES:

Energy: You gained a steady supply of electricity, **gain 2.**

Environment: You reduced reliance on nonrenewable and polluting energy sources, **gain 3.**

Economy: Installing solar panels was expensive, but voluntary bill increases from enthusiastic consumers made up for some of the difference, **lose 1.**

If you voted NO:

Energy: You missed your chance to invest in an alternative energy source, **lose 2.**

Environment: You continue to rely on polluting energy sources and greenhouse gases are building up faster every day, **lose 3.**

Economy: You saved a lot of money, but health care rates continue to go up in Tonga as more people suffer from lung ailments, **gain 1.**

STATUS REPORT

Hydroelectric Dam

If you voted YES:

Energy: You created a reliable source of electricity production. **Gain 3.**

Environment: You replaced a polluting fossil fuel plant with clean water power, but you destroyed almost half of the habitat for an endangered species, flooded a historic town and blocked the passage for fish. **Lose 2.**

Economy: Building the dam cost you a lot, but you created a steady source of electricity that will be around for a long time. **Gain 2.**

If you voted NO:

Energy: You missed a chance to gain a reliable source of electricity. **Lose 3.**

Environment: You continue to rely on a polluting fossil fuel plant, but you protected an endangered species, a historic town and important fish stocks, **Gain 2.**

Economy: you saved money by not building the dam, but your current electricity source costs more than hydro would have. **Lose 2.**

STATUS REPORT

Drilling for Oil

If you voted YES:

Energy: You provided gas for almost six years, **gain 3.**

Environment: Oil spilled at the well site killed off the Weeping Heron, a national treasure, **lose 5.**

Economy: The plan cost a lot, and unexpected environmental costs added even more, but surplus oil has brought needed capital to the island, **gain 2.**

If you voted NO:

Energy: The country you import oil from went to war, resulting in an oil shortage, **lose 3.**

Environment: You did not pollute the water with spilled oil and saved the weeping crane, **gain 5.**

Economy: You saved a lot by not drilling for oil, but the oil shortage has nearly doubled gas prices, **lose 2.**

STATUS REPORT

Wind Farm

If you voted YES:

Energy: You created a steady supply of energy, **gain 5.**

Environment: Wind power has helped reduce air pollution and greenhouse gas emissions. Bird kills were avoided by locating the wind machines out of migrating bird flyways, by using radar to detect birds and by building tube-shaped towers rather than horizontal supports which tend to be attractive bird perches. **Gain 3.**

Economy: Your wind farm produces energy fairly cheaply, **gain 3.**

If you voted NO:

Energy: You could not supply enough energy for air conditioning this summer and had to reduce power, resulting in brownouts, **lose 5.**

Environment: You continue to rely on polluting and greenhouse gas emitting fuels, **lose 3.**

Economy: Continued pollution drives up costs of health care, **lose 3.**

SR. VOTE CARD

Do we add three hydrogen fuel cell buses to the public bus system?

Energy Production: Hydrogen fuel-cell powered buses are 46% efficient, compared to diesel's 20% efficiency.

Energy Source: Hydrogen can be made by splitting water into oxygen and hydrogen using electricity. Hydrogen from water is a **renewable resource**.

Pollution: Fuel-cell vehicles emit no pollution. The only by-product is water vapor. Bus use will reduce pollution from personal vehicles

Greenhouse Effect: Fuel cells produce no greenhouse gases.

Land & Wildlife: Use of hydrogen reduces the need for oil drilling and the effects of oil spills on land and wildlife.

Investment Cost: \$9.6 million

Hidden Costs: The bus garage will need to be outfitted with noncombustible storage areas for the hydrogen buses, a special refueling area and increased ventilation.

Revenue: Argyle will be on the forefront of an exciting new technology; reduced reliance on foreign fuels; fuel cells will become cheaper with greater usage.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not turn over this card until *after* the vote.

SR. VOTE CARD

Do we convert half of our gasoline pumps to ethanol pumps?

Energy Production: Argyle can produce enough ethanol to fuel half of the cars on the island; ethanol is almost twice as efficient to produce as gasoline.

Energy Source: Ethanol is produced through the fermentation of corn wheat or sugar cane, all **renewable resources**.

Pollution: Ethanol-powered vehicles emit less CO than gas, but may increase SO₂ and NO_x emissions.

Greenhouse Effect: The use of traditional methods of agriculture (petroleum-based fertilizers, machinery, etc.) to grow ethanol crops may actually emit more CO₂ than gasoline (>42.8 lb CO₂/mil Btu)

Land & Wildlife: Farmers may have to convert land to grow fuel crops.

Investment Cost: \$4.5 million

Hidden Costs: May shift petroleum consumption and greenhouse gas emissions from vehicles to the agriculture industry. Without government subsidy, ethanol could not compete with gasoline in Argyle.

Revenue: Reduced reliance on foreign fuels; growth of local agriculture and ethanol refining industry.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we use passive solar design in the new Bunk City Hall?

Energy Production: Passive solar design can save 30% to 50% of heating energy and costs.

Energy Source: Passive solar design uses southern orientation, south-facing windows and overhangs, heat absorbing material, and insulation to capture and store the sun's heat, a **renewable resource**.

Pollution: Passive solar reduces dependence on polluting heat sources.

Greenhouse Effect: Passive solar reduces dependence on greenhouse gas emitting heat sources.

Land Consumption: A passive solar design requires certain sites with southern orientation, but no additional land area.

Investment Cost: The passive solar design will cost \$50,000 over the building's planned budget.

Hidden Costs: Possible heat loss from additional windows;

Revenue: Natural daylighting in the design will improve worker comfort and health and increase productivity.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we build a geothermal electricity plant near Steamy Hot Springs?

Energy Production: 100 MW

Energy Source: Hot water is brought to the surface from underground and flashed to steam. The steam turns a turbine engine which turns a generator. Spent water is reinjected into the well. Geothermal is a **renewable resource** if recharged and managed properly.

Pollution: Geothermal emits less NO_x, and at only a few percent of the SO₂ that fossil fuel plants emit; potential for toxic emissions.

Greenhouse Effect: .087 lb CO₂/million Btu

Land & Wildlife: Geothermal plants require only a fraction of the land needed by other energy generators and can commingle safely with other land uses.

Investment Cost: \$200 million (\$2000/kW)

Hidden Costs: frequent replacement of plant equipment due to corrosion; possible adverse effects on nearby Steamy Hot Springs, a popular tourist spot.

Revenues: Reduced reliance on foreign and nonrenewable resources; reduced pollution and CO₂ emissions;

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until after the vote.

SR. VOTE CARD

Do we convert all of Argyle's vehicles (80,000) to electric power?

Energy Production: Electric vehicles (EV's) get over twice the mileage of internal combustion engines from an equivalent amount of energy.

Energy Source: EV's get their power from batteries, rather than an internal combustion engine (ICE). The batteries must be charged by an existing electricity source.

Pollution: EV's emit no pollutants directly, but they may be charged by a polluting electricity source.

Greenhouse Effect: EV's emit no greenhouse gases directly, but their electricity source may emit greenhouse gases.

Land & Wildlife: Argyle would have to build EV charging stations, or convert gas stations to charging stations.

Investment Cost: \$320 million

Hidden Costs: batteries need replacement every 3-5 years; EV's can travel only a limited distance per charge;

Revenues: EV's are quiet; it is cheaper to charge an EV than to gas up an ICE vehicle; EV maintenance costs are half that of ICE's.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Should we build a biomass cogeneration plant in West Lulu?

Energy Production: 25 MW electricity plus heat to 3000 homes. Cogeneration is twice as efficient as electricity-only generation.

Energy Source: BioEnergy plants burn plant matter to create hot water and electricity. W. Lulu's plant would burn sunflower seed shells from nearby farms and wood chips from city pruning projects. BioEnergy is a **renewable resource**.

Pollution: Biomass emits 5% of the NOx that gas emits; 15% of the CO that vehicles emit; and 30% of the particulates coal emits.

Greenhouse Effect: There are no net emissions of CO2 because emissions are compensated for by CO2 absorbed during growth.

Land & Wildlife: The BioEnergy plant will burn existing waste products and not require the additional growth or cutting of fuel.

Investment Cost: \$4.4 million (\$1800/kW)

Hidden Costs: Potential for deforestation for fuel if wood and agricultural wastes do not meet demand.

Revenues: eliminating waste disposal problems; reducing reliance on nonrenewable resources;

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we install geothermal air-source heat pumps (GHPs) in 4000 homes and businesses?

Energy Production: Savings of 12 MW.

Energy Source: GHPs use a loop of plastic pipe filled with water and antifreeze and placed over 100 feet deep to transfer normal groundwater temperatures for winter heating, summer cooling and hot water heating. Ground heat is a **renewable resource**.

Pollution: GHPs emit no pollution; there is no contact between the antifreeze solution and the groundwater.

Greenhouse Effect: GHPs emit no greenhouse gases.

Land & Wildlife: GHPs take up the space of a normal gas furnace.

Investment Cost: \$40 million (\$3000/kW saved)

Hidden Costs: GHPs may need to be supplemented with other heating and cooling sources.

Revenue: reduced dependence on polluting heat sources; improved air quality;

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. EXTRA VOTE CARD

Use this card to research your own energy issue.

Energy Production:

Energy Source

Pollution:

Greenhouse Effect:

Land & Wildlife:

Investment Cost:

Hidden Costs:

Revenue:

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of this card until *after* the vote.

STATUS REPORT
Biomass Plant

If you voted YES:

Energy: You created a steady, local source of energy, gain 3.

Environment: You have solved a solid waste disposal problem, at the same time utilizing a renewable, lower-polluting resource, **gain 3.**

Economy: The plant was pretty inexpensive to build and using wood and agricultural wastes is much cheaper than mining coal, **gain 3.**

If you voted NO:

Energy: You can't keep up with energy demand on the island, **Lose 3.**

Environment: Acid rain is an increasing problem on the island, and the coal mines are having devastating effects on Argyle's mountains, **lose 3.**

Economy: Coal miners went on strike and the price of coal went up, **lose 3.**

STATUS REPORT
Electric Vehicles

If you voted YES:

Energy: It took more time than planned for the citizens of Argyle to accept the conversion to electric vehicles. Thus not as much energy was saved as had been hoped. **Gain 2.**

Environment: Air quality in the cities has improved greatly. **Gain 2.**

Economy: Converting to EVs was expensive and charging them has increased household electricity costs, but saved on gasoline expenses. Environmental health problems have decreased. **Gain 2.**

If you voted NO:

Energy: You saved electricity, but continue to use gasoline, which has grown scarce, due to an oil embargo, **Lose 2.**

Environment: Air quality has gotten worse, more people have been hospitalized for lung disease. **Lose 2.**

Economy: You saved money by not purchasing EVs, but gasoline expenses have gone up and the cost of health care to cover people suffering from lung disease is high. **Lose 2.**

EXTRA STATUS REPORT

If you voted YES:

Energy:

Environment:

Economy:

If you voted NO:

Energy:

Environment:

Economy:

STATUS REPORT
Geothermal Heat Pumps

If you voted yes:

Energy: You have taken a major load off of grid energy in many households, **gain 2.**

Environment: Geothermal heat pumps (GHPs) have reduced the use of polluting energy sources without damaging any land or wildlife resources, **gain 3.**

Economy: The GHPs were very expensive, but they should pay themselves off in reduced heating costs in less than 10 years, **lose 1.**

If you voted no:

Energy: The energy grid on Argyle continues to strain under the burden of high demand, **lose 2.**

Environment: Most homes continue to rely on polluting energy sources, **lose 3.**

Economy: You saved a lot of money by not investing in GHPs, but continue to pay high heating bills, **gain 1.**

STATUS REPORT

Ethanol Pumps

If you voted YES:

Energy: Ethanol has proved to be a great benefit for the island, reducing the impacts of an oil shortage, **gain 3**.

Environment: Carbon monoxide levels have improved somewhat, but farmland has degraded due to poor farming practices on fuel crop lands, **gain 1**.

Economy: When gas prices went up during the oil shortage, ethanol became competitively priced, increasing demand and lowering the price further, **gain 2**.

If you voted NO:

Energy: An oil shortage caused long lines at gas stations, **lose 3**.

Environment: Carbon monoxide levels remain high in some Argyle cities, **lose 1**.

Economy: Gas prices went up due to the oil shortage, **lose 2**.

STATUS REPORT

Hydrogen Buses

If you voted YES:

Energy: You are able to fuel 5% of the Bunk bus fleet without dependence of foreign fuels, **gain 2**.

Environment: Hydrogen from water is a zero emission fuel, the busses will help clean up Bunk's air, **gain 2**.

Economy: The bus project has been expensive, but international hydrogen research will benefit from your experiment, **lose 2**.

If you voted NO:

Energy: Your entire bus fleet continues to rely on foreign fuels, which might decline in the near future, **lose 2**.

Environment: Diesel fumes from the busses cause lung problems for many people in Bunk, **lose 2**.

Economy: You saved a lot of money by not investing in hydrogen fleets, **gain 2**.

STATUS REPORT

Geothermal Electricity

If you voted YES:

Energy: You created a major energy source for the island, **gain 2**.

Environment: Air quality has improved greatly in the areas the geothermal plant serves, and the hot springs have not shown any negative effects so far, **gain 3**.

Economy: Despite high maintenance costs, the geothermal plant has created numerous jobs for islanders, **gain 1**.

If you voted NO:

Energy: You missed your chance at a major energy source, **lose 2**.

Environment: The geothermal plant could have solved a lot of air quality problems on the southern half of the island, **lose 3**.

Economy: You saved a lot by not building the plant, but the price of fossil fuels has continued to rise, and the unemployment rate on Argyle is high, **lose 1**.

STATUS REPORT

Passive Solar

If you voted YES:

Energy: You saved 25% on energy usage in the new city hall, officials plan on using passive solar design in all future projects, when feasible, **gain 2**.

Environment: You reduced reliance on polluting energy sources, **gain 2**.

Economy: The addition of solar design cost \$50,000, but saved almost half of the building's heating costs, **gain 2**.

If you voted NO:

Energy: You missed your chance to conserve energy, now you have to increase generating capacity to meet the needs of the new building, **lose 2**.

Environment: You continue to rely on polluting energy sources, **lose 2**.

Economy: The heating bills for the City Hall are 25% higher than they would have been with passive solar design, **lose 2**.

JR. VOTE CARD

Do we build a hydropower dam on the Lute River?

Hydropower: Moving water has been used as a source of energy for thousands of years. Today, hydroelectric plants generate electricity by using falling water to turn turbines. Hydroelectric dams store water in a reservoir. Water is a **renewable resource**.

Fact: A hydroelectric plant will improve air quality on argyle and reduce greenhouse gas emissions by reducing the island's reliance on fossil fuels for energy.

Fact: The dam will flood out the town of Glenn, displace 8000 residents; destroy some of the habitat for the endangered Argyle Woolly Cat and block passages for fish stocks;

Fact: hydropower requires 20 times more land area than solar power.

Investment Cost: \$70 million

Energy Production: 25 Megawatts of power.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we finance a 4000-rooftop solar electricity generation program?

Solar Electricity: Energy from the sun is converted to electricity by photovoltaic (PV) panels made from purified silicon chips. The sun is a **renewable resource**.

Fact: Solar electricity emits no pollutants or greenhouse gases, however, making PV panels requires the use of some hazardous materials and non-renewable resources.

Fact: PV panels will be placed on existing rooftops, requiring no additional land usage.

Investment Cost: \$84.8 million (\$5300/kW)

Energy Production: 16 Megawatts of power

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we build a 600-machine wind farm on Argyle's mountains?

Wind Power: Wind machines use turning blades to collect the wind's energy. The blades connect to a drive shaft that turns a generator to make electricity. The Argyle mountain tops have wind conditions favorable for a wind farm location. Wind is a **renewable resource**.

Fact: Wind machines cause no air or water pollution and produce no greenhouse gases.

Fact: birds can be killed or injured by wind machine turbines;

Fact: some people find wind farms are unattractive noisy;

Fact: wind power requires less than half the land area required by coal power.

Investment Cost: \$300 million (\$1000/kW).

Energy Production: 300 Megawatts of Power.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we drill for oil in the Wiggly Ocean?

Oil: Oil is found by drilling wells beneath the ground or the ocean floor. We use oil to make gasoline and many consumer products, including plastics. Oil is a **non-renewable resource**.

Fact: When burned to create energy, oil forms products that can harm humans and most other life forms and add to global climate change.

Fact: An oil spill could damage the marine environment, killing plants and animals.

Investment Cost: \$75 million

Environmental Cost: Potential spill cleanup; pollution caused health problems; transportation; refining.

Energy Production: Geologists estimate that enough oil lies off the south coast to provide Argyle with 5 years' worth of gasoline.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we invest in conserving energy by insulating Argyle homes?

Energy Conservation: Conservation means voluntarily reducing your energy use.

Fact: Conservation cuts the need for energy from all sources.

Fact: Conservation reduces reliance on polluting and greenhouse gas emitting energy sources, but some insulating materials are made from toxic substances at polluting factories.

Fact: Energy Conservation requires up-front costs that can be scary to consumers.

Investment Cost: \$75 million

Energy Production: If we reduce energy consumption by 20% through conservation, we could provide enough energy to power an additional 80,000 homes on Argyle.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we build a nuclear power plant at Figtown?

Nuclear Power: Nuclear Power plants use heat from atomic reactions to run steam generators, which make electricity. Nuclear fuels like uranium and plutonium are **non-renewable resources**.

Fact: Nuclear power plants do not produce air pollution or any greenhouse gases.

Fact: Radioactive nuclear fuel is dangerous and must be disposed of in special sites. Fallout from a meltdown would devastate Argyle.

Investment Cost: \$1.2 billion

Energy Production: 600 megawatts of power

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we drill for natural gas in the Wiggly Ocean and build a pipeline?

Natural Gas is found by drilling beneath the ground or the ocean floor. Near the Bing Islands there are large deposits of natural gas. Natural gas is a **non-renewable resource**.

Fact: Natural gas emits less pollution and less carbon dioxide than coal and oil.

Fact: Building a pipeline from the east coast to Figtown would cut a 75-foot wide swath through Wildwoods National Park, nearby woods and farmland, and displace some homes.

Investment Cost: \$460 million

Energy Production: geologists estimate enough natural gas exists in offshore reserves to heat homes and power factories on Argyle for 15-25 years.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

ROLE CARD

Each team member will play one (or more than one if the team has fewer than six players) of the following roles for the duration of the game:

The READER/FACILITATOR will:

- play the role of "Chair" of the legislative body by reading the questions and facts on the Vote card.
- make sure everyone is doing his/her job
- read the status sheets (alternatively, the player who lands on the Vote square can read the vote card and status sheet for that play)

The RECORD KEEPER will:

- Record each voting issue and the reasons for or against the issue on the Record card.
- conduct the vote after all discussion is completed.
- record the result of the vote on the Record card.
- Share the group's results with the rest of the class during the wrap-up period.

The MAP MAKER will:

- Use a grease pencil or dry erase marker to draw the result of each vote on a piece of mylar covering the map. For instance, if the vote results in a hydro dam being built on the Lute River, draw the dam and reservoir on the map.

JR. VOTE CARD

Do we add three hydrogen fuel cell buses to the public bus system?

Hydrogen can be made by splitting water into oxygen and hydrogen using electricity. Hydrogen from water is a **renewable resource**.

Fact: Fuel-cell vehicles emit no pollution and no greenhouse gases. The only by-product is water vapor. Bus use will reduce pollution from personal vehicles

Land & Wildlife: Use of hydrogen reduces the need for oil drilling and the effects of oil spills on land and wildlife.

Investment Cost: \$9.6 million

Energy Production: Hydrogen fuel-cell powered buses are 46% efficient, compared to diesel's 20% efficiency.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not turn over this card until *after* the vote.

JR. VOTE CARD

Do we convert half our gasoline pumps to ethanol pumps?

Ethanol is produced through the fermentation of corn wheat or sugar cane, all **renewable resources**.

Pollution: Ethanol-powered vehicles emit less CO than gas, but may increase SO₂ and NO_x emissions.

Facts: The use of traditional methods of agriculture (petroleum-based fertilizers, machinery, etc.) to grow ethanol crops may actually emit more CO₂ than gasoline (>42.8 lb CO₂/mil Btu)

Fact: Farmers may have to convert land to grow fuel crops.

Investment Cost: \$4.5 million

Energy Production: Argyle can produce enough ethanol to fuel half of the cars on the island.

Discuss this issue for 5-10 minutes, then vote YES or NO.

JR. VOTE CARD

Do we use passive solar design in the new Bunk City Hall?

Passive solar design uses southern orientation, south-facing windows and overhangs, heat absorbing material, and insulation to capture and store the sun's heat, a **renewable resource**.

Fact: Passive solar reduces dependence on polluting and greenhouse gas emitting heat sources.

Fact: A passive solar design requires certain sites with southern orientation, but no additional land area.

Investment Cost: The solar will cost \$50,000 over the building's budget.

Energy Production: Passive solar design can save 10% to 40% of heating energy needs and costs.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we build a geothermal electricity plant near Steamy Hot Springs?

Geothermal Power: Hot water is brought to the surface from underground and flashed to steam. The steam turns a turbine engine which turns a generator. Spent water is reinjected into the well. Geothermal is a **renewable resource** if recharged and managed properly.

Pollution: Geothermal emits much less pollution than fossil fuel plants and only a fraction of the carbon dioxide.

Fact: Geothermal plants require only a fraction of the land needed by other energy generators and can commingle safely with other land uses.

Fact: Many people are concerned that a geothermal power plant might damage nearby Steamy Hot Springs, a popular tourist spot.

Investment Cost: \$200 million (\$2000/kW)

Energy Production: 100 MW

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we convert all of Argyle's vehicles (80,000) to electric power?

Electric Vehicles (EV's) get their power from batteries, rather than an internal combustion engine (ICE). The batteries must be charged by an existing electricity source.

Fact: EV's emit no pollutants or greenhouse gases directly, but they may be charged by a polluting electricity source.

Fact: Argyle would have to build EV charging stations, or convert gas stations to charging stations.

Investment Cost: \$320 million

Energy Production: Electric vehicles (EV's) get over twice the mileage of internal combustion engines from an equivalent amount of energy.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Should we build a biomass cogeneration plant in West Lulu?

BioEnergy plants burn plant matter to create hot water and electricity. W. Lulu's plant would burn sunflower seed shells from nearby farms and wood chips from city pruning projects. BioEnergy is a **renewable resource**.

Fact: Biomass emits fewer pollutants than coal, gasoline and oil.

Fact: There are no net emissions of carbon dioxide because emissions are compensated for by CO₂ absorbed during growth.

Fact: The BioEnergy plant will burn existing waste products and not require the additional growth or cutting of fuel.

Investment Cost: \$4.4 million (\$1800/kW)

Energy Production: 25 MW electricity plus heat to 3000 homes. Cogeneration is twice as efficient as electricity-only generation.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we install geothermal air-source heat pumps (GHPs) in 4000 homes and businesses?

Geothermal Heat Pumps use a loop of plastic pipe filled with water and antifreeze and placed over 100 feet deep to transfer normal groundwater temperatures for winter heating, summer cooling and hot water heating. Ground heat is a **renewable resource**.

Fact: GHPs emit no pollution and no greenhouse gases; there is no contact between the antifreeze solution and the groundwater.

Fact: GHPs take up the space of a normal gas furnace, not adding any pressures to land and wildlife issues.

Investment Cost: \$40 million (\$3000/kW saved)

Energy Production: Savings of 12 MW.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. EXTRA VOTE CARD

Use this card to research your own energy issue.

Energy Source:

Fact:

Fact:

Fact:

Investment Cost:

Energy Production:

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of this card until *after* the vote.